Ostro House Documentation

1 Abstract

Detached House in Kippen, Stirlingshire, Central Scotland

1.1 Data of building

Year of construction	2016	**Space heating**	**15 kWh/(m^2a)**
U-value external wall	0.09 W/(m^2K)		
U-value ground floor	0.12 W/(m^2K)	**Primary Energy Renewable (PER)**	37 kWh/(m^2a)
U-value roof	0.072 W/(m^2K)	**Generation of renewable energy**	31 kWh/(m^2a)
U-value window (average)	0.82 W/(m^2K)	**Non-renewable Primary Energy (PE)**	79 kWh/(m^2a)
Heat recovery	91 %	Pressure test n_{50}	0.2 h-1
Special features	All timber construction. Untreated Siberian larch timber cladding. Sedum roof. 100% LED lighting. Low flow fixtures and fittings plus WWHR (water saving). Photovoltaic panels: 1.5 kWh array installed. Solar thermal hot water system. SUDS scheme (sustainable method for disposing of surface water and rainwater from any roof or hard landscaping around the building to prevent the risk of flooding.)		

1.2 Brief Description ...

Ostro Passive House, Kippen, Stirlingshire

This detached new build Passivhaus building was self-built by the architect and her husband over a number of years, designed as a family home, and also contains their home office space, from which they run their architectural practice.

Located within the historical conservation village of Kippen, near Stirling, the site was a large south facing plot, featuring a small burn, and facing woodland and fields to the south and west respectively. The house enjoys a semi-rural setting and is clad 100% in naturally weathered timber to reflect the woodland that it faces. The project is an exemplar low-energy home: as well as achieving Passivhaus Certification, the proposal meets the demanding requirements of the Scottish Technical Standards Section 7: Sustainability Gold Level.

The design for the house is based on the concept of a 'box within a box'. The inner box is conceived as a homogenous sculptural form that is present in every space and is articulated in black stained timber; it contains all of the wet services and circulation and serves the other spaces. The outer box is a rainscreen of naturally weathered timber cladding fixed on a 30° angle, with vertically orientated, punched out triple glazed openings. The rooms exist as spaces between the inner and outer boxes.

The building has a due south orientation and sits on a sloping site behind a street of other houses. The house measures 10.5m x 10.5m internally, and has a TFA of c.170m2 as there is a large double height space in the south-west corner. The clients have lived here since 2016, achieved Certification in 2017, and have recently started internal temperature and humidity monitoring to validate their anecdotal experience of living with maximised thermal comfort.

1.3 Responsible project participants / Verantwortliche Projektbeteiligte

Architect/ Entwurfsverfasser	Mhairi Grant of Paper Igloo Ltd. http://www.paperigloo.com
Implementation planning/ Ausführungsplanung	Mhairi Grant of Paper Igloo Ltd. http://www.paperigloo.com
Building systems/ Haustechnik	Heat Recovery Scotland https://www.paulheatrecovery.co.uk/
Structural engineering/ Baustatik	Clyde Design Partnership http://www.clydedesign.co.uk
Building physics/ Bauphysik	Mhairi Grant of Paper Igloo Ltd. http://www.paperigloo.com
Passive House project planning/ Passivhaus-Projektierung	Mhairi Grant of Paper Igloo Ltd. http://www.paperigloo.com
Construction management/ Bauleitung	Self-built by clients, Mhairi Grant & Martin McCrae

Certifying body/ Zertifizierungsstelle	CoCreate Consulting (now Etude) https://www.etude.co.uk/

Certification ID/ Zertifizierungs ID	Project-ID (www.passivehouse-database.org) Projekt-ID (www.passivehouse-database .org)	5043

Author of project documentation / Verfasser der Gebäude-Dokumentation	Mhairi Grant of Paper Igloo Ltd. http://www.paperigloo.com
Date, Signature/ Datum, Unterschrift	17/01/2021

2 Views of Ostro Passivhaus

The South elevation is shown on the cover page and again in the second image below.

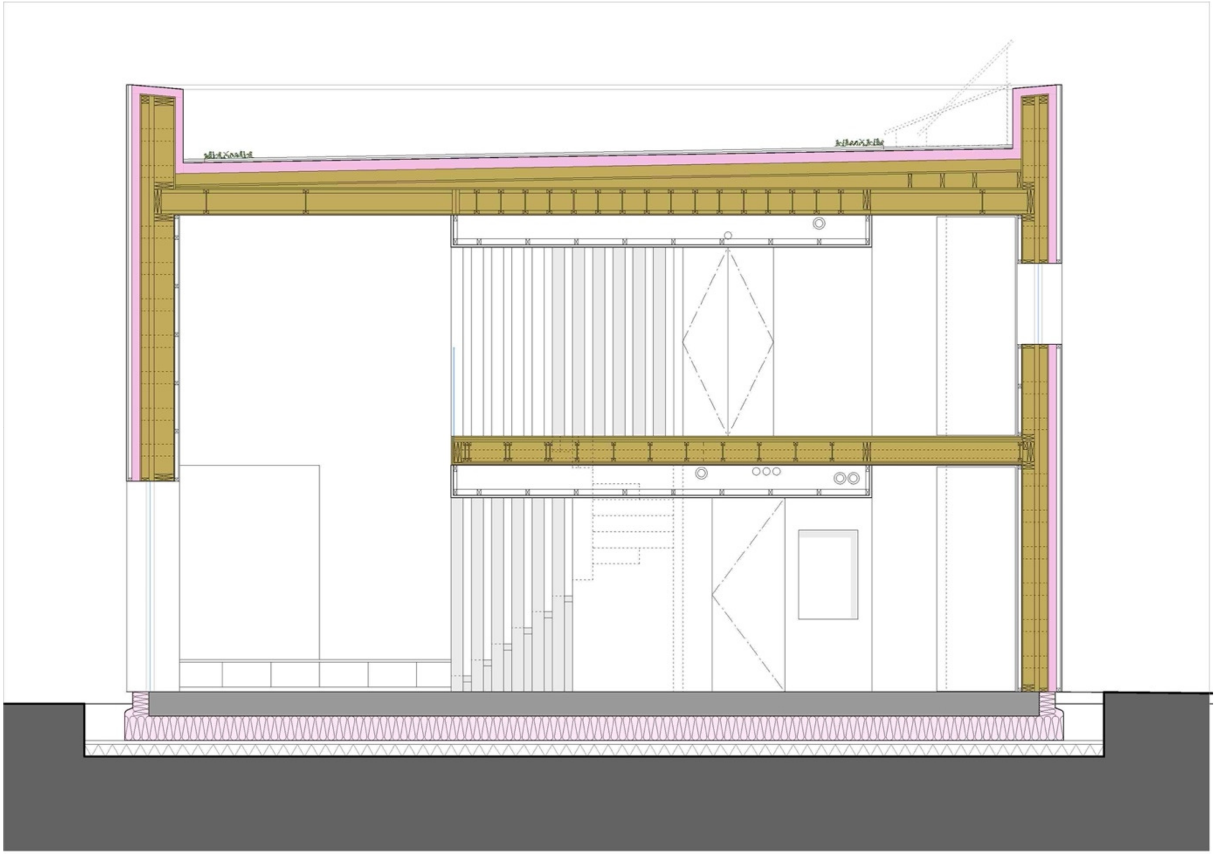
West Elevation of Ostro passivhaus. There are no external shading devices.

East (and south) Elevations of Ostro passivhaus. The adhoc window arrangement can clearly be seen.

The North Elevation of Ostro Passivhaus. The MVHR grille can be seen at first floor level. This elevation has minimal openings.

The main internal living spaces, showing the double height in the south west corner, from which the photo has been taken, and the inner service core articulated in black timber.

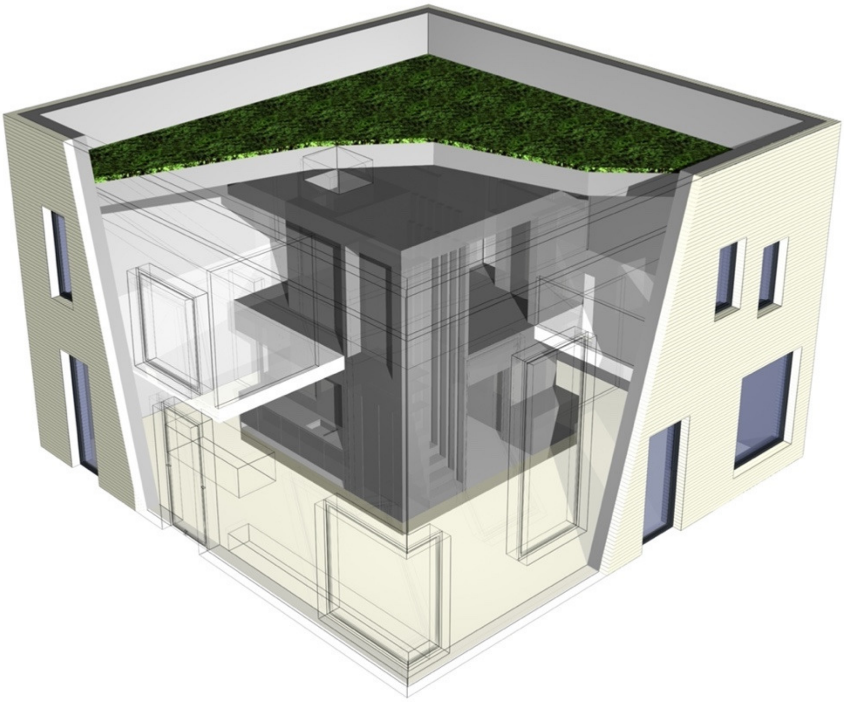
3 Sectional Drawing & 3-D cutaway of Ostro Passivhaus



The cross section clearly shows the insulated raft foundation by Isoquick, the twin-wall timber frame construction (shown in brown) and the external wrap of continuous Gutex insulation (pink), which also extends up and over the parapet to ensure complete continuity.

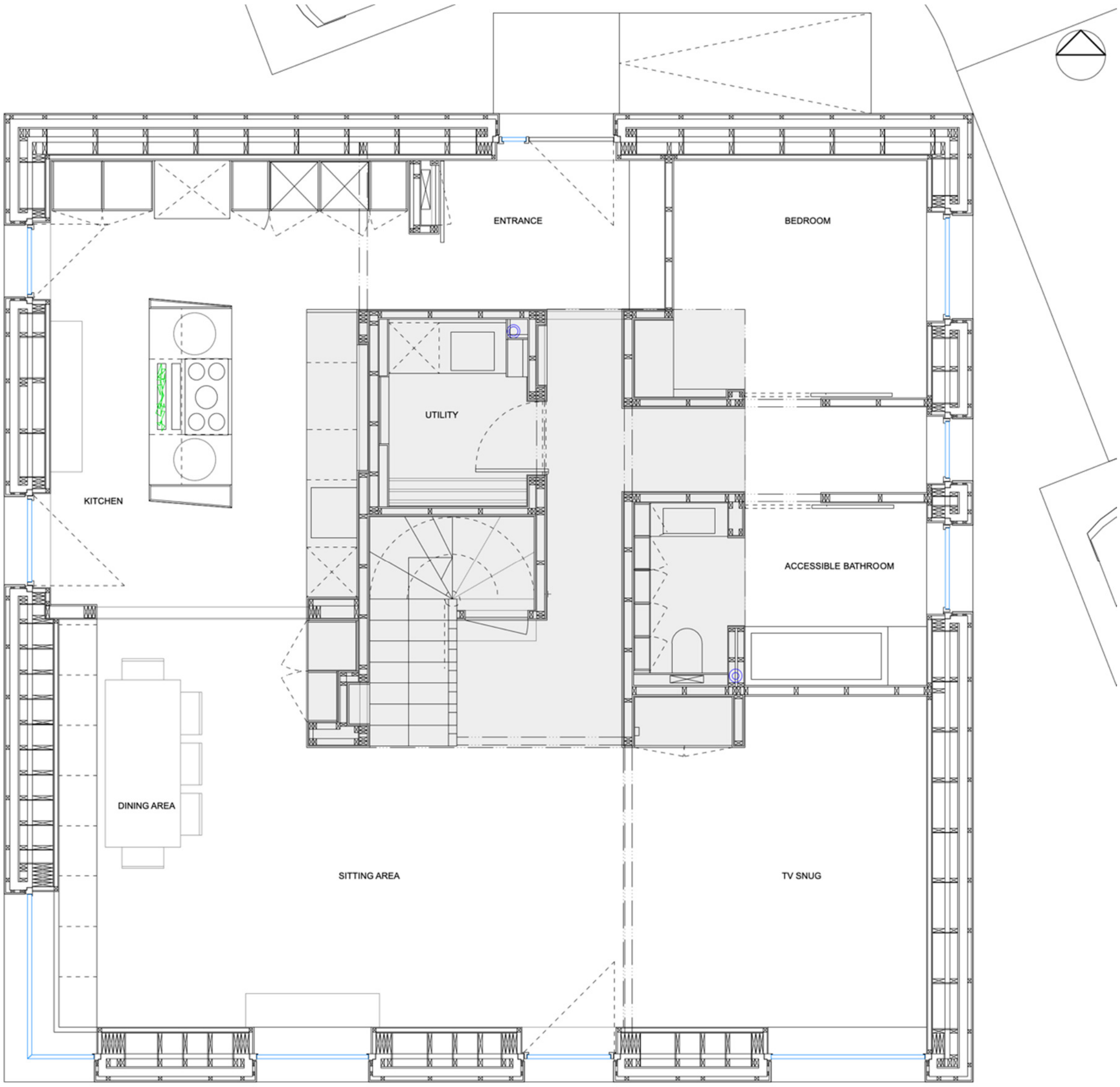
Each floor has a lowered ceiling in the central service core which contains all of the ductwork fort he MVHR, sprinkler system and general pipework. On the roof you can see the PV and solar thermal panels, which are partly concealed by the parapet.

In this section on the south side (left) is the double height space, with the staircase visible in the centre, and the entrance hallway on the north side of the building (right).



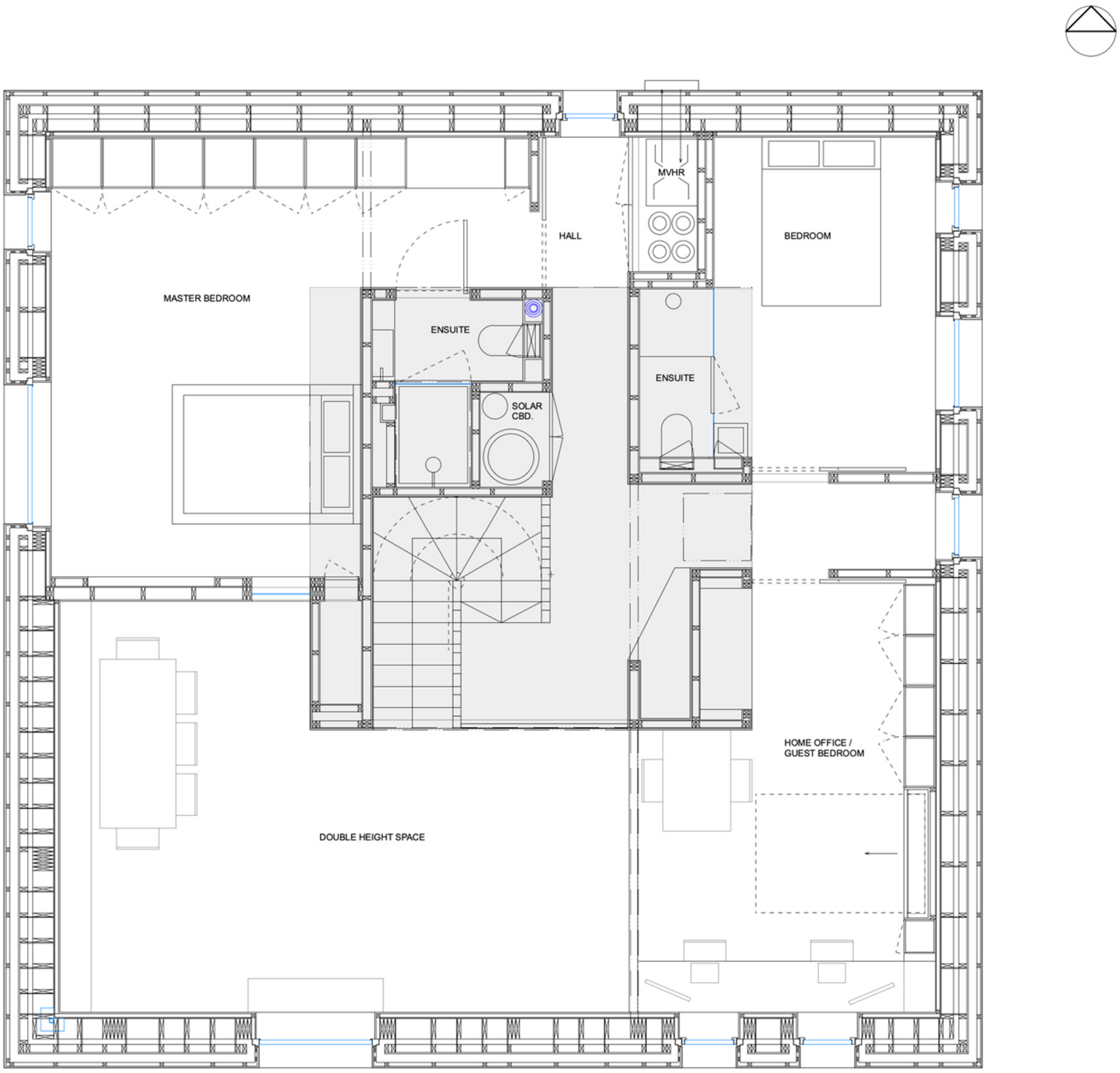
This 3-D cutaway, looking from the south west corner, also shows the inner service core, the parapet and sedum roof covering.

4 Floor Plans of Ostro Passivhaus



The Ground Floor Plan: to the north is the entrance door with a single narrow window adjacent. In the north east corner is a double bedroom, and immediately below that is the accessible bathroom. In the south east corner is the TV sitting space, and in the south west corner under the double height are the dining and secondary sitting spaces. In the north west corner is the kitchen. The whole of the ground floor, with the exception of the bedroom and bathroom, is open-plan.

The central core is articulated in the grey shaded area and contains the utility room and the staircase.



The First Floor Plan: again there are minimal windows to the north. Two more bedrooms are orientated either due west or east facing, both with ensuites contained within the central service core.

The home office faces due south and overlooks the double height space. The master bedroom, on the west, has a glazed slot which overlooks the double height space also, and allows south sunlight deep into the plan during the winter months.

5 Construction details of the envelope and Passivhaus technology in Ostro Passivhaus

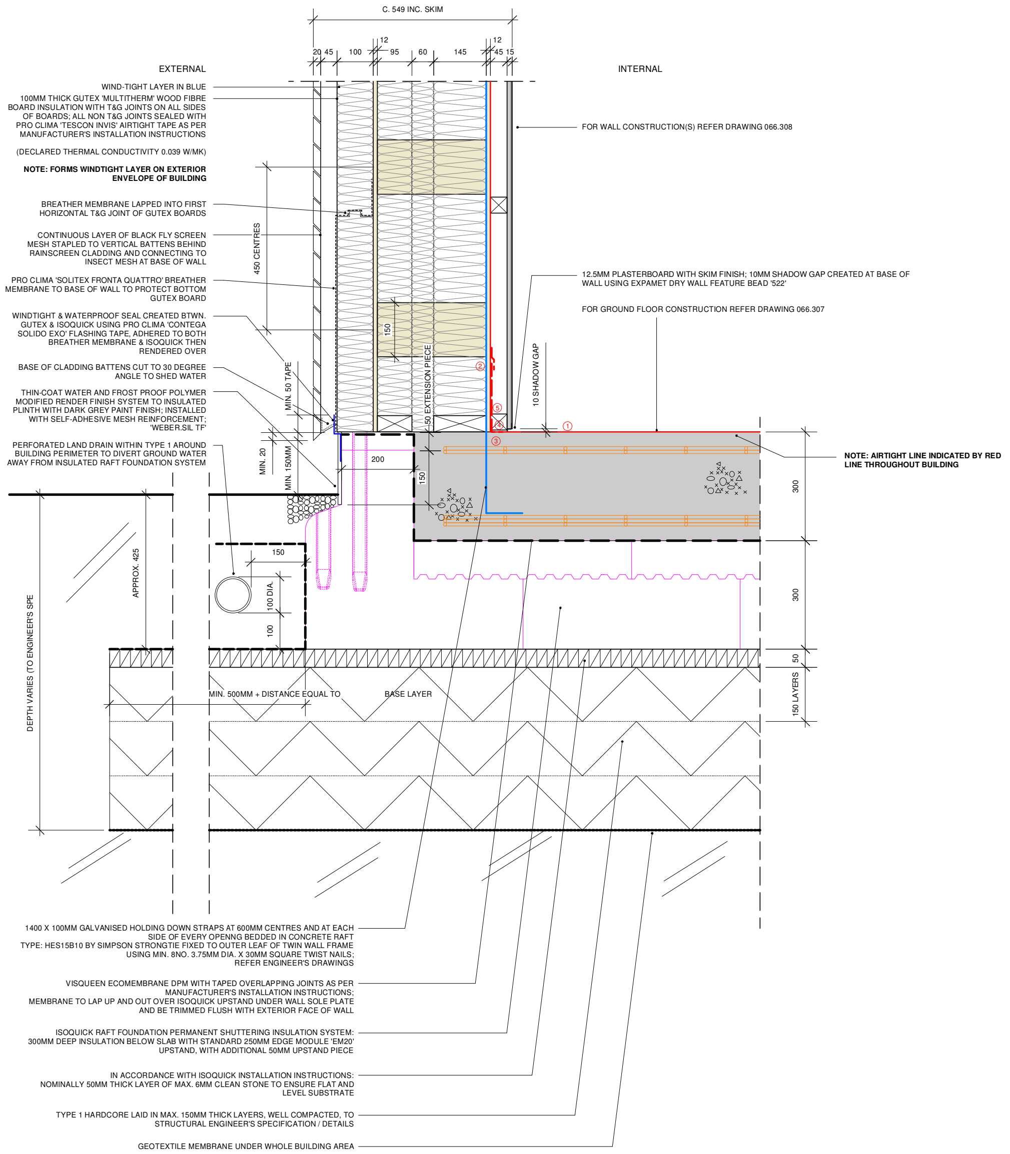
5.1 Construction including insulation of the ground floor slab with connection points of the external walls. Drawing shows 145mm inner stud area (note: 245mm inner stud in double height).

AIRTIGHTNESS SEQUENCING:

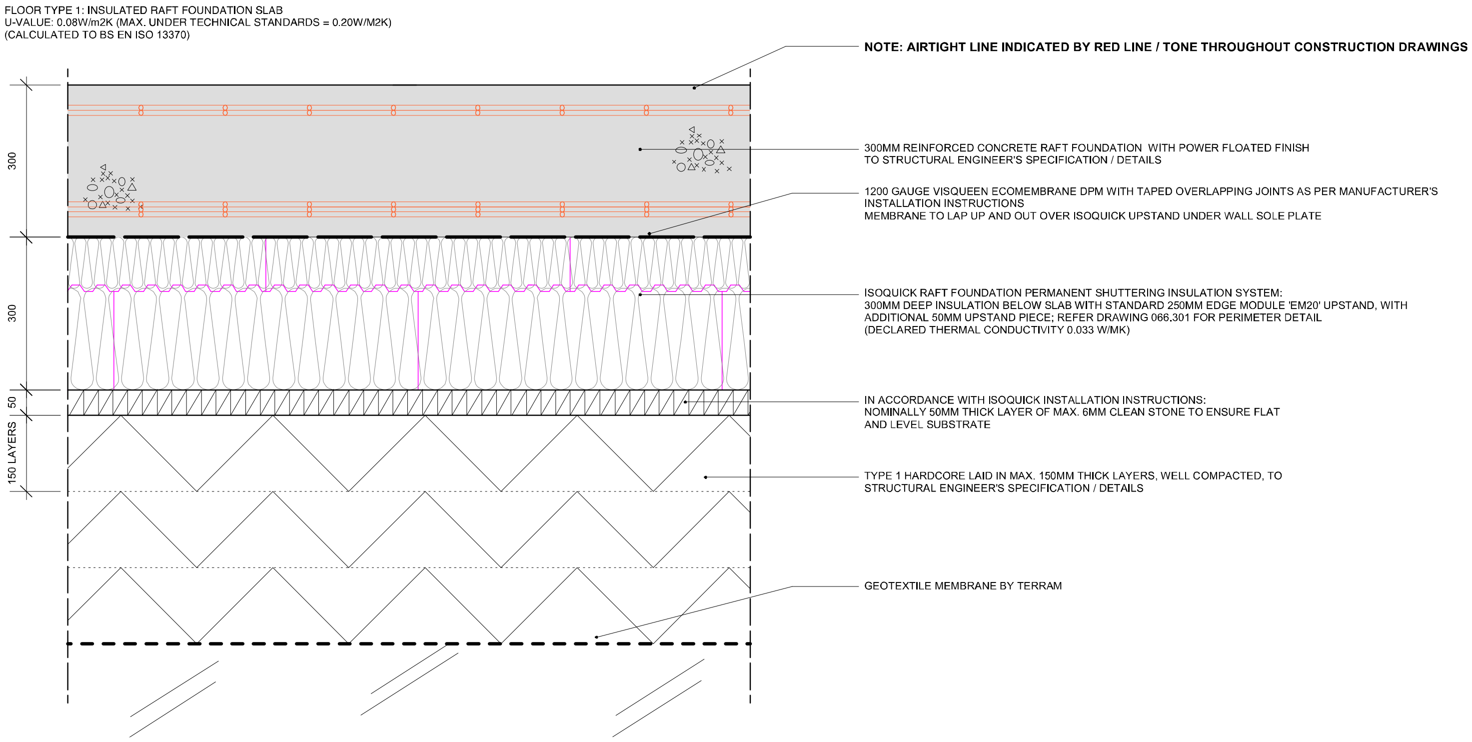
1. POUR CONRETE SLAB TO FORM AIRTIGHTNESS LAYER OVER GROUND FLOOR (INDICATED BY RED LINE ON SECTION BELOW)
2. CONSTRUCT INNER LEAF OF TWIN WALL: SPANO DURELIS 'VAPOURBLOCK' BOARD PROVIDES AIRTIGHTNESS LAYER ON EXTERNAL WALLS (INDICATED BY RED LINE BELOW)
3. PRIME 40MM ZONE AT EDGE OF CONCRETE FLOOR USING TESCON PRIMER RP
4. FORM JUNCTION AT FLOOR EDGE WITH PRO CLIMA 'DA-S' TAPE ADHERED TO FLOOR WITH MIN. 6MM BEAD OF 'ORCON F' SEALER
5. TAPE 'DA-S' TAPE TO DURELIS 'VAPOURBLOC' RACKING BOARD USING PRO CLIMA TESCON NO. 1 TAPE

NOTES:

1. PSI VALUE TARGET FOR JUNCTION: <0.01W/MK (THERMAL BIRDGE FREE CONSTRUCTION)
2. AIRTIGHTNESS VALUE TO BE ACHIEVED: MAX. 0.6 ACH / HR AT 50PA



TYPICAL SECTION THROUGH WALL / GROUND FLOOR JUNCTION WITH WALL TYPE 1: 145MM & 95MM TWIN WALL TIMBER FRAME
(NOTE: FOR WALL TYPE 2 DETAIL REMAINS CONSISTENT)



These 2 drawings show the construction of the ground floor slab insulated raft formwork where it meeets the external wall (top) and the floor construction itself (above).

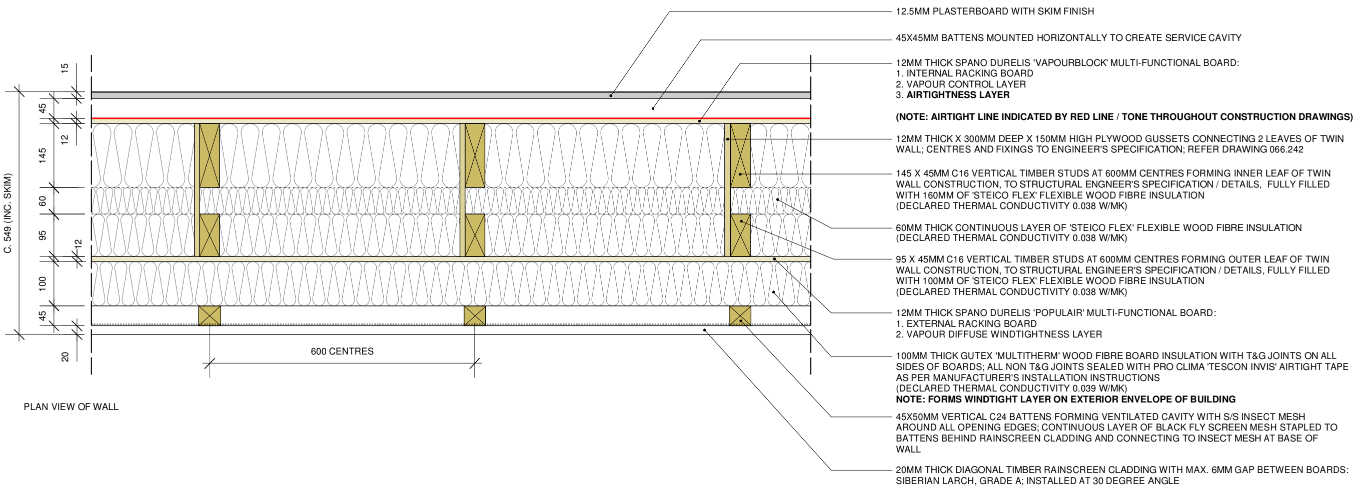
These 4 images show the construction of the ground floor slab insulated raft formwork (top left); the poured concrete slab with strcutural tie-down straps which sit inside the timber frame (bottom left); the twin-wall timber frame construction with a 145mm inner stud sitting correctly over the Isoquick to ensure continuity of insulation (top right); and the external layer of Gutex wood fibre insulation being installed and restrained by the cladding battens (bottom right). This construction ensures a very high level of thermal performance where the timber kit of the external walls meets the ground floor construction, and in particular the Isoquick upstand, which was thicker than standard to give better continuity.

Ground floor build up: Min. 600mm compacted Type 1 sub-base laid in 150mm deep layers, 50mm cleaned and compacted max. 6mm stone blinding, 300mm thick Isoquick EPS insulated formwork system, 1200 gauge Visqueen ‘Ecomembrane’ DPM (100% recycled polyethylene), 300mm reinforced concrete slab power floated to form floor finish throughout ground floor.

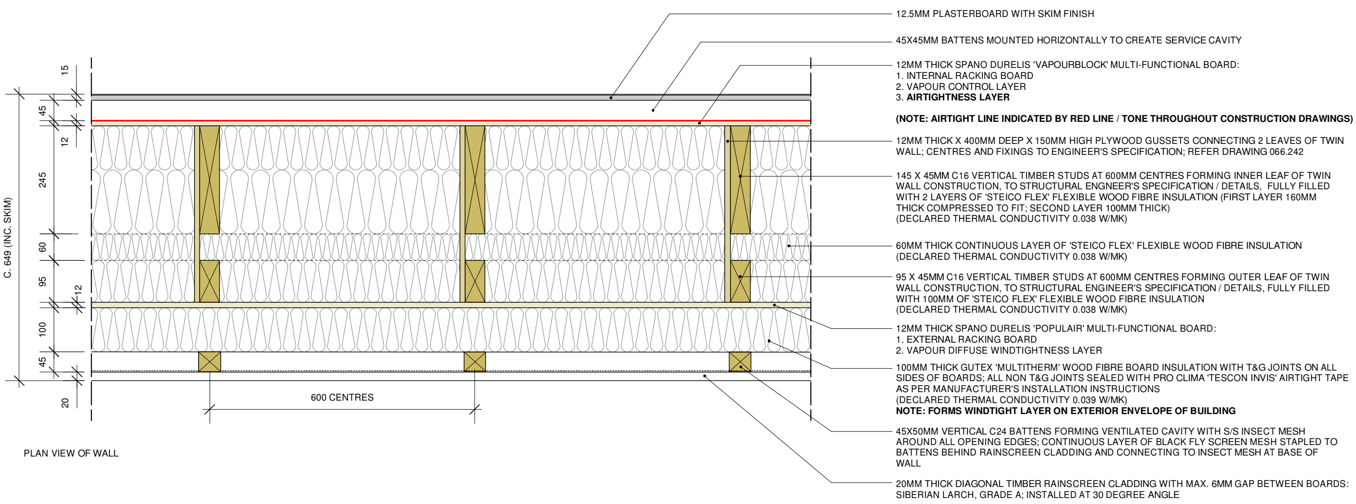
U-Value: 0.122W/m²K

5.2 Construction including insulation of the exterior walls, including at the intermediate floor junction. Drawing shows 145mm inner stud area (note: 245mm inner stud in double height).

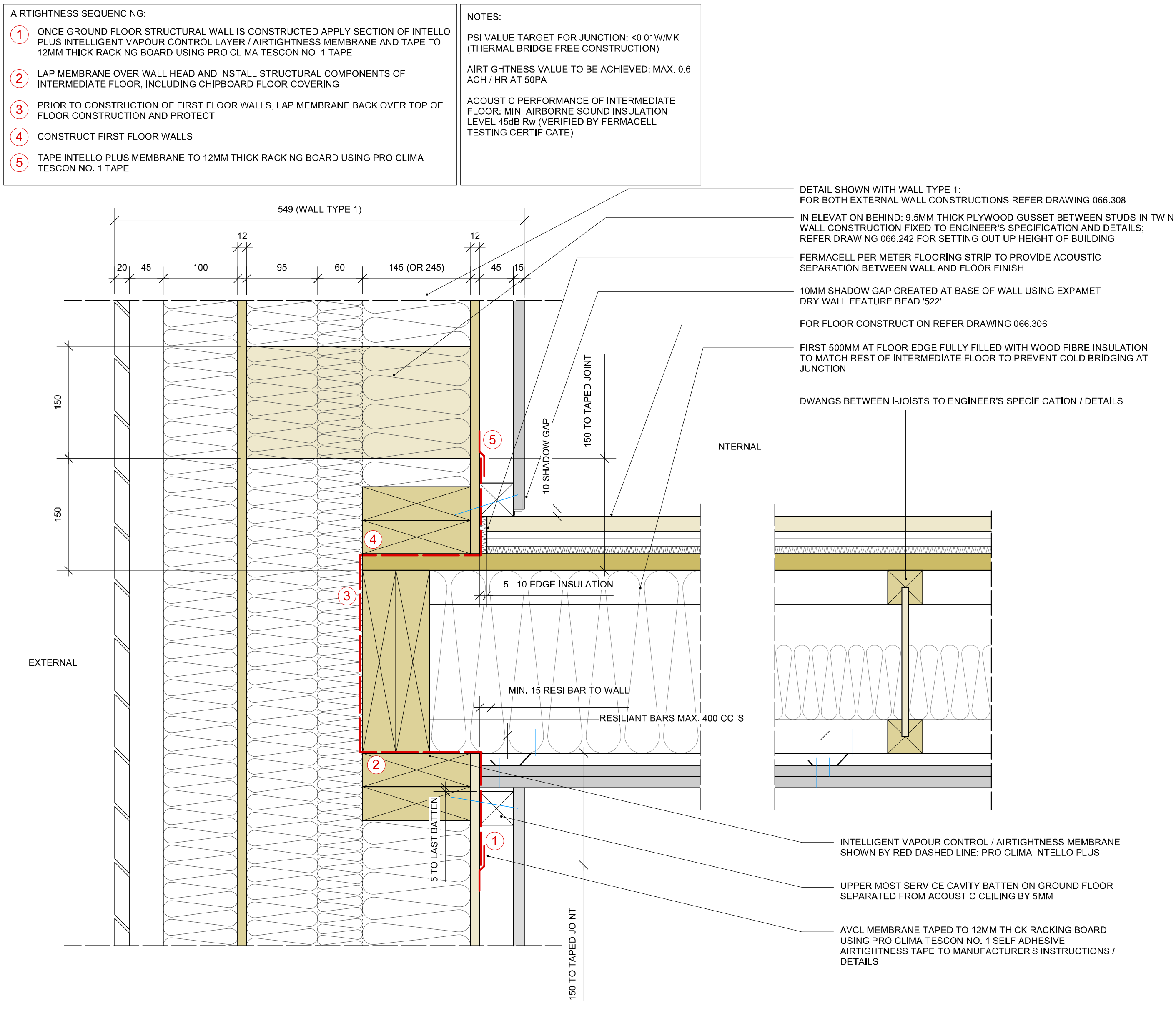
EXTERNAL WALL TYPE 1: TWIN-FRAME 145MM INNER STUD
U-VALUE: 0.11W/m2K (MAX. UNDER TECHNICAL STANDARDS = 0.25W/M2K)
(CALCULATED TO BS EN ISO 6946)



EXTERNAL WALL TYPE 2: TWIN-FRAME 245MM INNER STUD
U-VALUE: 0.10W/m2K (MAX. UNDER TECHNICAL STANDARDS = 0.25W/M2K)
(CALCULATED TO BS EN ISO 6946)



This drawing shows the external wall construction in both the areas with 145mm load-bearing studs, and 245mm load bearing studs (double height). The whole wall construction is filled with wood fibre insulation batts.



TYPICAL SECTION THROUGH INTERMEDIATE FLOOR JUNCTION WITH WALL TYPE 1

This drawing shows the process of the continuity of both the insulation at the intermediate floor construction by way of the 60mm deep thermal break between the two timber frame leaves, and the continuity of the airtight membrane, which was taken out behind the floor construction and then wrapped back in to be connected to the upper floor walls during construction.

These 4 images show the insulation of the timber frame. The double height 245mm studs being insulated (top left); the parapet inner frame being insulated (bottom left); the overinsulation at the window frames (top right); and the fully filled insulated ground floor wall (bottom right).

These 4 images show the thermal break in the timber frame wall construction (top left); the internal vapour control and airtightness board, which also served a structural purpose (top right); the airtight seal between ground floor wall and concrete slab (bottom left); the airtight seal around the intermediate floor at the bottom of the first floor wall panel (bottom right).

External Walls: Stick-built on site twin-wall timber frame with 20mm thick Siberian larch cladding (untreated & unfinished) externally, followed inside by 45 x 50mm deep treated timber vertical battens forming drained and ventilated cavity, 100mm thick Gutex ‘Multitherm’ t&g wood fibre insulation boards, 12mm thick Spano Durelis ‘Populair’ vapour diffuse racking board, 45 x 95mm deep vertical timber studs with 100mm compressed Gutex ‘Thermoflex’ flexible wood fibre insulation between, 60mm continuous layer of Gutex ‘Thermoflex’ flexible wood fibre insulation forming thermal break, 45 x 145mm deep vertical timber studs with 160mm compressed Gutex ‘Thermoflex’ flexible wood fibre insulation between (9mm thick plywood gussets holding two timber leafs together), 12mm thick Spano Durelis ‘vapourblock’ airtight internal AVCL board, joints and all screw holes taped with Pro Clima Tescon Vana tape, 45 x 45mm timber battens forming service cavity, and 12.5mm plasterboard internally.

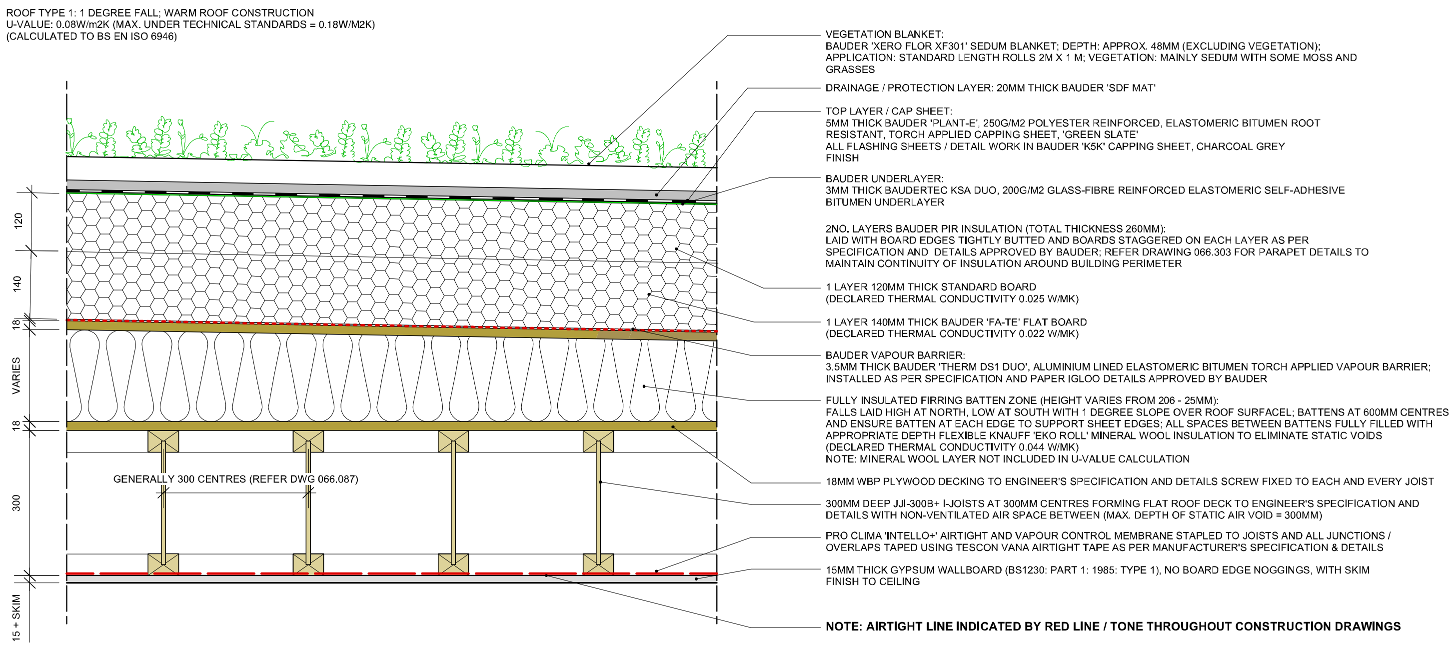
Note: in double height areas construction matches above except for inner stud = 245mm deep filled with 260mm compressed insulation.

U-Values calculated in PHPP per wall due to variations in stud spacing / timber fraction.

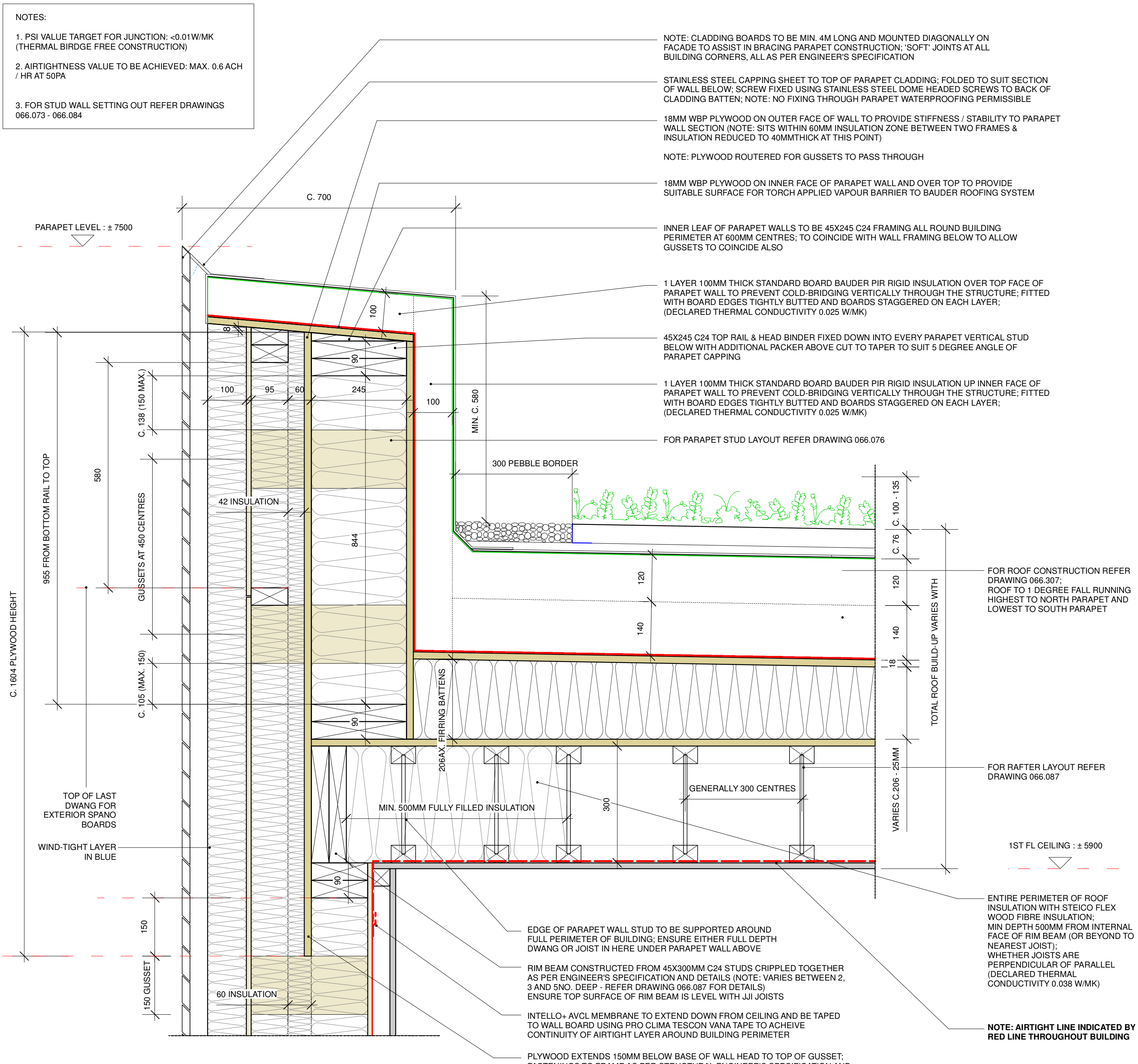
Average U-Value: 0.100W/m^{2}K (145mm stud walls).

Average U-Value: 0.086W/m^{2}K (245mm stud walls).

5.3 Construction including insulation of the flat roof, including at the parapet. Drawing shows 145mm inner stud area (note: 245mm inner stud in double height).



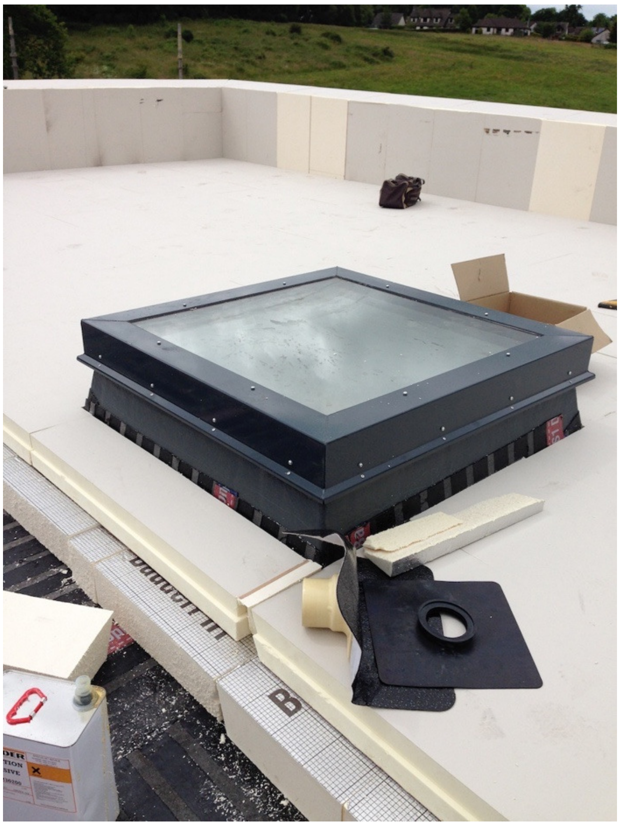
The house has a green roof system by Buader, with an extensive sedum blanket. The roof structure was constructed as a flat deck made from 300mm deep I-Joists, with a 1° fall created by timber firring battens, which were insulated between with mineral wool insulation, and then all of the rigid Bauder PIR insulation added above another plywood deck. The main stuctural zone remained uninsulated except for the very perimeter, which was insulated with the same wood fibre insulation as the external walls to mitigate any thermal bridge at the junction with the parapet.



SEDUM ROOF DETAIL 1: TYPICAL SECTION THROUGH MAIN ROOF
(CUT THROUGH NORTH ELEVATION WHERE FIRRING BATTENS ARE THICKEST)

The house has a well insulated parapet around the whole of the roof perimeter as shown above.



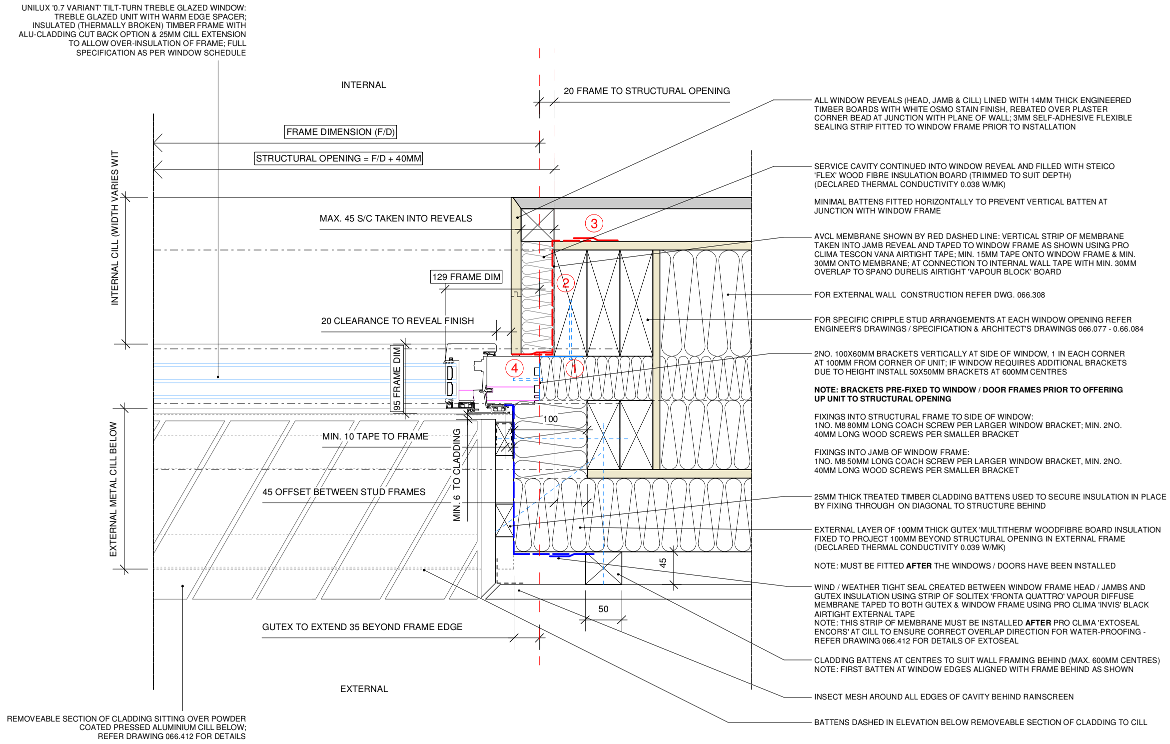
These 6 images show the first structural deck with firring zone being filled with insulation (top left); the secondary deck on the 1* fall (top right); the Bauder VCL and insulation wrapping up the parapet (middle left); the two layers of Bauder insulation mid-install taken up over the proprietary insulated upstands of the rooflights (middle right); the green Bauder capping sheet with the extensive sedum blanket including drainage matting being installed (bottom left); the finished sedum blanket (bottom right).

Roof: Flat roof with 1 degree fall finished with Bauder 'XF301' extensive sedum blanket on Bauder 'SDF' drainage mat, on Bauder 'Plant-E' felt capping sheet, on Bauder 'KSA-Duo' felt underlayer, on 120mm thick Bauder PIR insulation, on 140mm thick Bauder PIR 'FA-TE' insulation, on Bauder 'DS1-Duo' torch applied vapour barrier, on 18mm plywood, on min. 25mm deep x 45mm wide firring battens to create 1° fall fully filled with Knauf Eko Roll mineral wool insulation, on 18mm plywood deck, on 300mm deep JJI 300B+ I-Joists to form roof structure with static airspace between, on Pro Clima Intello Plus AVCL to ceiling, with 15mm thick TE Wallboard plasterboard to form ceiling.

U-Value: 0.072W/m^{2}K (including tapered layers)

Roof has fully insulated parapet to perimeter finished in matching felt Bauder waterproofing system.

5.4 Window and rooflight sections including installation drawings



NOTES:

1. PSI VALUE TARGET FOR JUNCTION: 0.01W/MK THERMAL BRIDGE FREE JUNCTION

2. MAX. AIRTIGHTNESS VALUE TO BE ACHIEVED: 0.6 ACH / HR AT 50PA

AIRTIGHTNESS SEQUENCING:

(1) INSTALL WINDOW IN STRUCTURAL OPENING USING PRE-ATTACHED GALVANISED METAL BRACKETS FIXED INTO STRUCTURAL MEMBERS AROUND ALL SIDES EXTERNALLY

(2) AT JAMBS:

CUT STRIP OF 'INTELLO +' AVCL MEMBRANE AND WRAP INTO WINDOW REVEAL, ENSURING MIN. 50MM OVERLAP ONTO 12MM THICK SPANO DURELIS 'VAPOUR BLOCK' AIRTIGHT RACKING BOARD AND MIN. 15MM OVERLAP ONTO WINDOW FRAME

(3) TAPE INTELLO + MEMBRANE TO 12MM THICK SPANO DURELIS 'VAPOUR BLOCK' AIRTIGHT RACKING BOARD USING PRO CLIMA TESCON VANA TAPE AS PER MANUFACTURER'S INSTRUCTIONS

(4) TAPE INTELLO + MEMBRANE TO WINDOW FRAME USING PRO CLIMA TESCON VANA TAPE AS PER MANUFACTURER'S INSTRUCTIONS

DETAIL 1: TYPICAL PLAN THROUGH TILT-TURN WINDOW JAMB

FOR EXTERNAL WALL CONSTRUCTION REFER DWG. 066.308

FOR SPECIFIC LINTEL TYPES REFER ENGINEER'S DRAWINGS / SPECIFICATION & ARCHITECT'S DRAWINGS 066.077 - 0.66.084

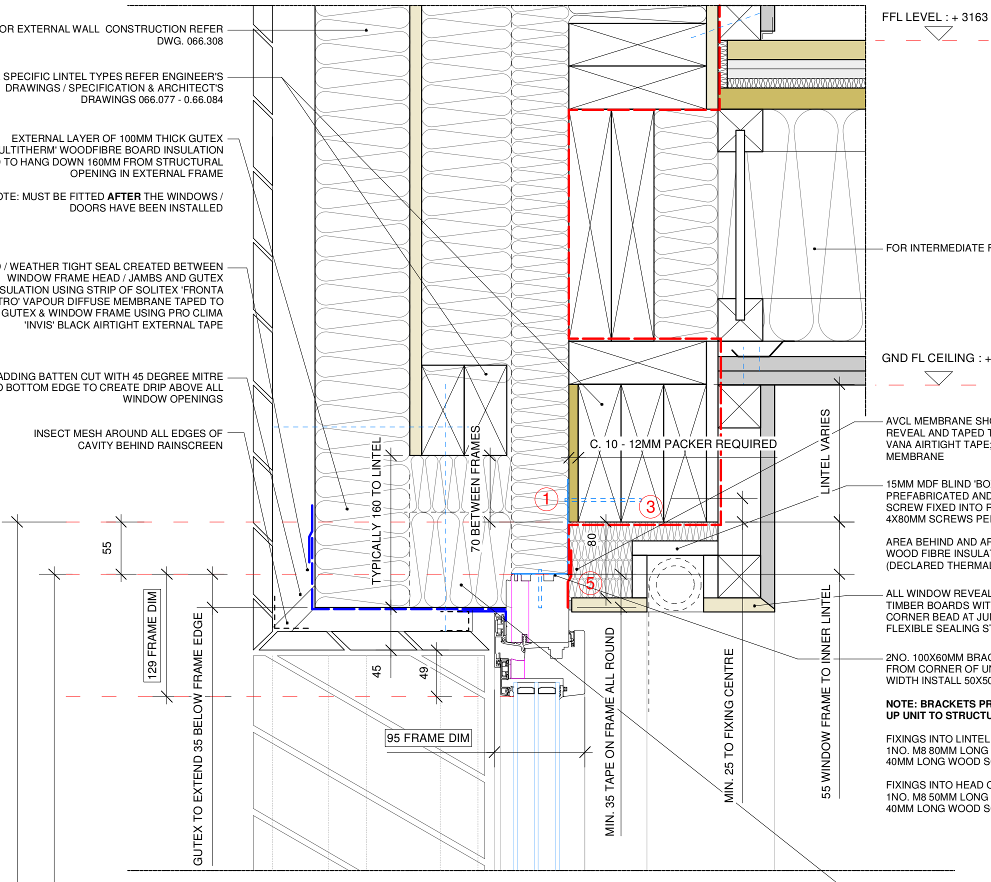
EXTERNAL LAYER OF 100MM THICK GUTEX 'MULTITHERM' WOODFIBRE BOARD INSULATION FIXED TO HANG DOWN 160MM FROM STRUCTURAL OPENING IN EXTERNAL FRAME

NOTE: MUST BE FITTED **AFTER** THE WINDOWS / DOORS HAVE BEEN INSTALLED

WIND / WEATHER TIGHT SEAL CREATED BETWEEN WINDOW FRAME HEAD / JAMBS AND GUTEX INSULATION USING STRIP OF SOLITEX 'FRONTA QUATTRO' VAPOUR DIFFUSE MEMBRANE TAPED TO BOTH GUTEX & WINDOW FRAME USING PRO CLIMA 'INVIS' BLACK AIRTIGHT EXTERNAL TAPE

CLADDING BATTEN CUT WITH 45 DEGREE MITRE TO BOTTOM EDGE TO CREATE DRIP ABOVE ALL WINDOW OPENINGS

INSECT MESH AROUND ALL EDGES OF CAVITY BEHIND RAINSCREEN



NOTES:

1. PSI VALUE TARGET FOR JUNCTION: 0.01W/MK THERMAL BRIDGE FREE JUNCTION
2. MAX. AIRTIGHTNESS VALUE TO BE ACHIEVED: 0.6 ACH / HR AT 50PA

FOR INTERMEDIATE FLOOR CONSTRUCTION REFER DWGS 066.306 & 066.401

AVCL MEMBRANE SHOWN BY RED DASHED LINE: MEMBRANE TAKEN INTO HEADER REVEAL AND TAPED TO WINDOW FRAME AS SHOWN USING PRO CLIMA TESCON VANA AIRTIGHT TAPE; MIN. 15MM TAPE ONTO WINDOW FRAME & MIN. 30MM ONTO MEMBRANE

15MM MDF BLIND 'BOX' PREFABRICATED AND OFFERED UP TO CONSTRUCTION AFTER WINDOW IS FITTED SCREW FIXED INTO RIM BEAM ABOVE THROUGH INSULATION USING MAX. 3NO. 4X80MM SCREWS PER BOX

AREA BEHIND AND AROUND BLIND BOX FILLED WITH GUTEX 'MULTITHERM' RIGID WOOD FIBRE INSULATION BOARD (TRIMMED TO SUIT DEPTH) (DECLARED THERMAL CONDUCTIVITY 0.039 W/MK)

ALL WINDOW REVEALS (HEAD, JAMB & CILL) LINED WITH 14MM THICK ENGINEERED TIMBER BOARDS WITH WHITE OSMO STAIN FINISH, REBATED OVER PLASTER CORNER BEAD AT JUNCTION WITH PLANE OF WALL; 3MM SELF-ADHESIVE FLEXIBLE SEALING STRIP FITTED TO WINDOW FRAME PRIOR TO INSTALLATION

2NO. 100X60MM BRACKETS AT HEAD OF WINDOW, 1 IN EACH CORNER AT 100MM FROM CORNER OF UNIT; IF WINDOW REQUIRES ADDITIONAL BRACKETS DUE TO WIDTH INSTALL 50X50MM BRACKETS AT 600MM CENTRES

NOTE: BRACKETS PRE-FIXED TO WINDOW / DOOR FRAMES PRIOR TO OFFERING UP UNIT TO STRUCTURAL OPENING

FIXINGS INTO LINTEL ABOVE WINDOW:
1NO. M8 80MM LONG COACH SCREW PER LARGER WINDOW BRACKET; MIN. 2NO. 40MM LONG WOOD SCREWS PER SMALLER BRACKET

FIXINGS INTO HEAD OF WINDOW FRAME:
1NO. M8 50MM LONG COACH SCREW PER LARGER WINDOW BRACKET, MIN. 2NO. 40MM LONG WOOD SCREWS PER SMALLER BRACKET

DETAIL 1: TYPICAL TILT-TURN WINDOW HEAD

ADDITIONAL LAYERS GUTEX 'MULTITHERM' RIGID WOODFIBRE BOARD INSULATION FIXED UP INTO LINTEL ABOVE WITH 25MM THICK TREATED TIMBER CLADDING BATTENS TO SECURE INSULATION IN PLACE (GENERALLY 160MM THICK BUT THIS IS REDUCED TO 140MM ON WINDOWS / DOORS THAT EXTEND RIGHT TO FIRST FLOOR CEILING LINE - REFER THERMAL MODELS FOR VARIANTS) (DECLARED THERMAL CONDUCTIVITY 0.039 W/MK)

NOTE: MUST BE FITTED **AFTER** THE WINDOWS / DOORS HAVE BEEN INSTALLED

EXTERNAL

INTERNAL

BATTENS DASHED IN ELEVATION BEHIND CLADDING; CLADDING TO MATCH MAIN WALL RETURNED INTO WINDOW / DOOR REVEALS ON 30 DEGREE ANGLE

UNILUX '0.7 VARIANT' TILT-TURN TREBLE GLAZED WINDOW: TREBLE GLAZED UNIT WITH WARM EDGE SPACER; INSULATED (THERMALLY BROKEN) TIMBER FRAME WITH ALU-CLADDING CUT BACK OPTION & 25MM CILL EXTENSION TO ALLOW OVER-INSULATION OF FRAME; FULL SPECIFICATION AS PER WINDOW SCHEDULE

AVCL MEMBRANE SHOWN BY RED DASHED LINE: MEMBRANE TAKEN INTO REVEAL AT CILL AND TAPED TO WINDOW FRAME AS SHOWN USING PRO CLIMA TESCON VANA AIRTIGHT TAPE; MIN. 15MM TAPE ONTO WINDOW FRAME & MIN. 30MM ONTO MEMBRANE

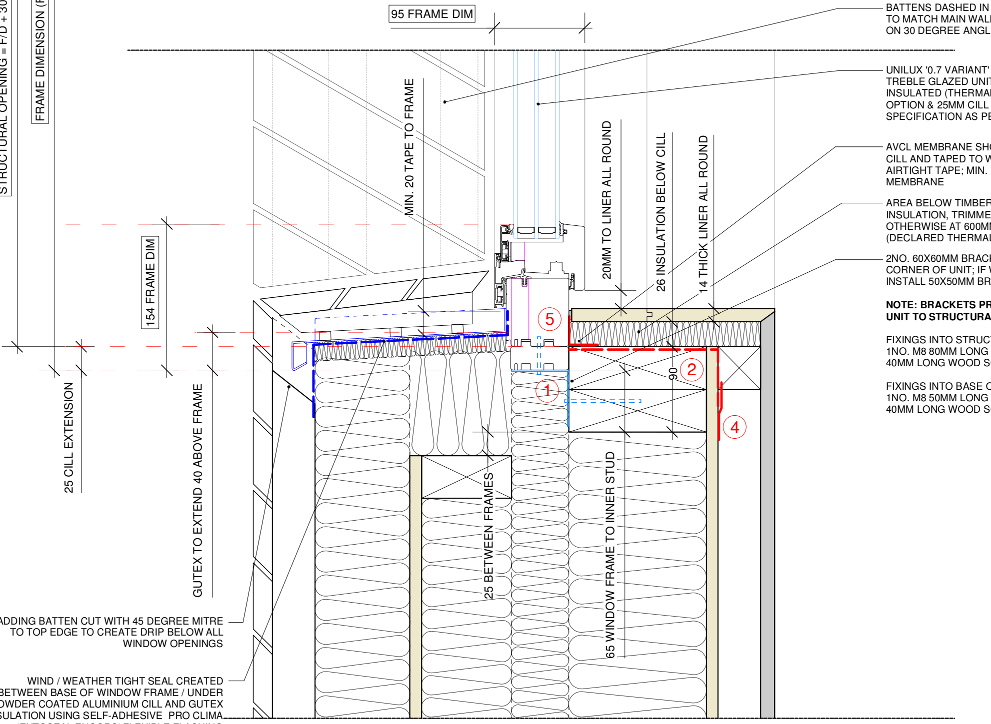
AREA BELOW TIMBER CILL BOARDS FILLED WITH STEICO 'FLEX' WOOD FIBRE INSULATION, TRIMMED TO SUIT DEPTH; BATTENS AT EDGES, CENTRE & OTHERWISE AT 600MM CC'S TO TAKE TIMBER LINER (DECLARED THERMAL CONDUCTIVITY 0.038 W/MK)

2NO. 60X60MM BRACKETS AT BASE OF WINDOW, 1 IN EACH CORNER AT 100MM FROM CORNER OF UNIT; IF WINDOW REQUIRES ADDITIONAL BRACKETS DUE TO WIDTH INSTALL 50X50MM BRACKETS AT 600MM CENTRES

NOTE: BRACKETS PRE-FIXED TO WINDOW / DOOR FRAMES PRIOR TO OFFERING UP UNIT TO STRUCTURAL OPENING

FIXINGS INTO STRUCTURAL TIMBER AT WINDOW CILL LEVEL:
1NO. M8 80MM LONG COACH SCREW PER LARGER WINDOW BRACKET; MIN. 2NO. 40MM LONG WOOD SCREWS PER SMALLER BRACKET

FIXINGS INTO BASE OF WINDOW FRAME:
1NO. M8 50MM LONG COACH SCREW PER LARGER WINDOW BRACKET, MIN. 2NO. 40MM LONG WOOD SCREWS PER SMALLER BRACKET



CLADDING BATTEN CUT WITH 45 DEGREE MITRE TO TOP EDGE TO CREATE DRIP BELOW ALL WINDOW OPENINGS

WIND / WEATHER TIGHT SEAL CREATED BETWEEN BASE OF WINDOW FRAME / UNDER POWDER COATED ALUMINIUM CILL AND GUTEX INSULATION USING SELF-ADHESIVE PRO CLIMA 'EXTOSEAL ENCORS' FLEXIBLE FLASHING ADHERED TO BOTH PRE-PRIMED GUTEX & WINDOW FRAME; MIN. LAP TO WALL FACE: 75MM

DETAIL 2: TYPICAL TILT-TURN WINDOW CILL

AIRTIGHTNESS SEQUENCING:

1. INSTALL WINDOW IN STRUCTURAL OPENING USING PRE-ATTACHED GALVANISED METAL BRACKETS FIXED INTO STRUCTURAL MEMBERS AROUND ALL SIDES EXTERNALLY
2. CUT STRIP OF 'INTELLO +' AVCL MEMBRANE AND WRAP INTO WINDOW REVEAL, ENSURING MIN. 50MM OVERLAP ONTO 12MM THICK SPANO DURELIS 'VAPOUR BLOCK' AIRTIGHT RACKING BOARD AND MIN. 15MM OVERLAP ONTO WINDOW FRAME
3. AT HEAD: IF MEMBRANE FROM INTERMEDIATE FLOOR JUNCTION IS NOT LONG ENOUGH EXTEND WITH A FURTHER STRIP OF INTELLO + AND TAPE JUNCTION USING TESCON VANA TAPE
4. TAPE INTELLO + MEMBRANE TO 12MM THICK SPANO DURELIS 'VAPOUR BLOCK' AIRTIGHT RACKING BOARD USING PRO CLIMA TESCON VANA TAPE AS PER MANUFACTURER'S INSTRUCTIONS
5. TAPE INTELLO + MEMBRANE TO WINDOW FRAME USING PRO CLIMA TESCON VANA TAPE AS PER MANUFACTURER'S INSTRUCTIONS


GUTEX Multither

These 5 images show the thermal break in the strcutural timber frame with the insulation extending over the timber part of the window frame (top left); the Gutex installation at the exterior window frame (top right); the Gutex installation at the exterior window frame from side view (bottom left); the window sealed with flashing tape under the aluminium sill (middle right); the internal airtight membrane and taping of the window installation prior to insulation in the reveal (bottom right).

Windows & external doors:

The windows and glazed doors were by Unilux and were all uncertified components. The glazed units were triple glazed with argon gas fill, in aluminium clad thermally broken timber frames. The g-values ranged from 0.46 – 0.51 depending on the various safety glass requirements, and the U-g values were 0.5W/m^{2}K for non-safety glass units to 0.6W/m^{2}K for safety glass units. The largest window (on the south elevation to the double height space), and the narrow side-light coupled with the opaque front door, both had a U-g value of 0.7W/m^{2}K. Frame U-Values were 0.92W/m^{2}K throughout apart from the base of the patio style doors, which was 1.6W/m^{2}k. The spacer PSI value was 0.043W/mK, although all units passed the thermal comfort criterion and all fRSI values were checked and compliant.

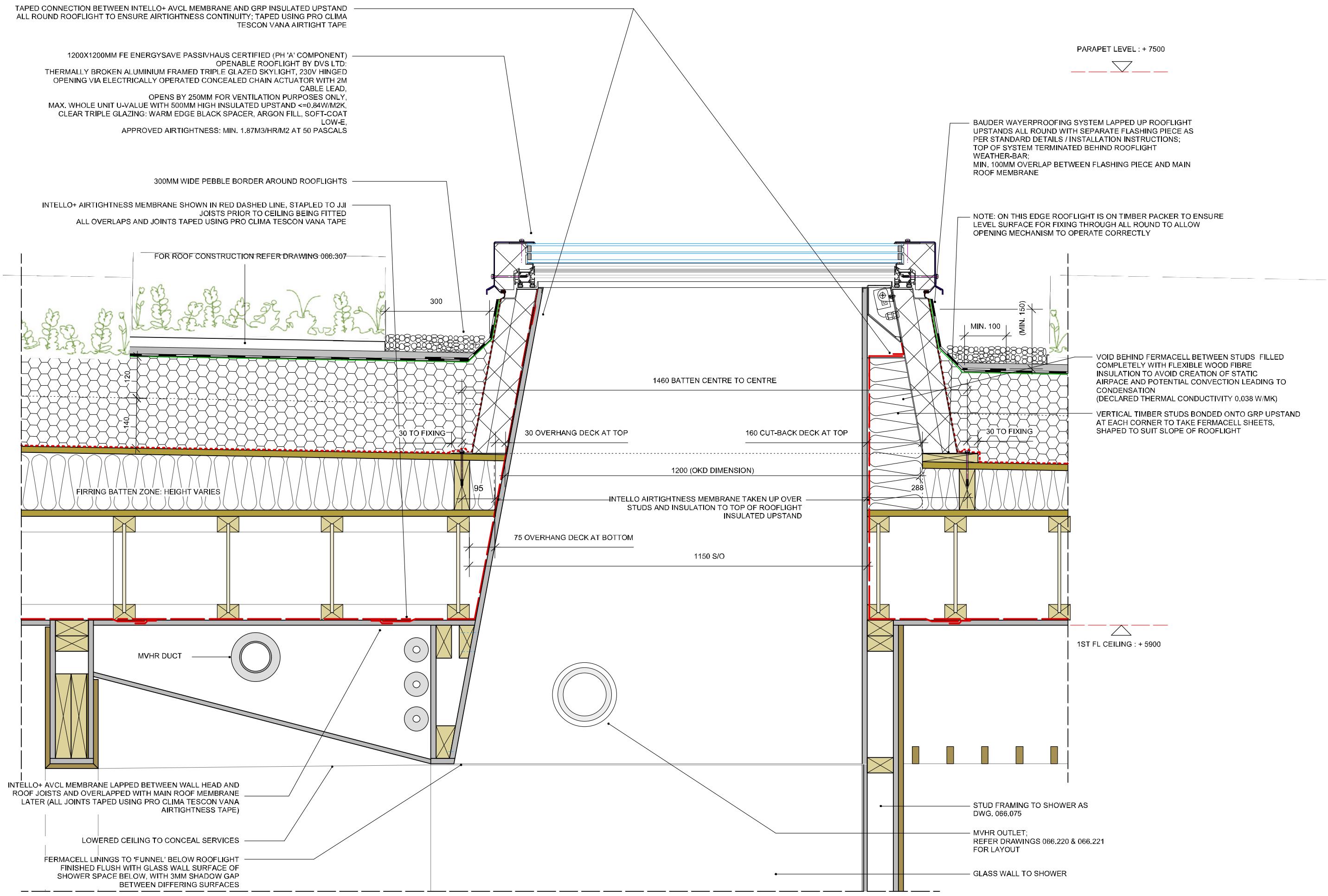
All window installations were thermally modelled and the frames set within an insulated reveal detail both internally by extending the service cavity into the reveal depth, and externally by extending the Gutex woodfibre insulation over the timber part of the window frame. The aluminium cladding was cut-back to ensure it was not encapsulated by the exterior insulation. All window installation junctions were numerically analysed in PSI Therm software and calculated thermal bridge values entered into PHPP.

The front door is the only opaque door in the property, and has an aluminium finish on both sides with insulation core. The installed U-Value of the front door is 1.09W/m^{2}K.

Windows / Glazed Doors: Triple glazed, argon fill thernally broken, alu-clad.

Overall whole-window / glazed door average U-Value for the project of 0.82W/m^{2}K

ROOFLIGHT RW-01 DETAIL 1: SECTION THROUGH ROOFLIGHT



The drawing above shows a cross section through one of the rooflights (the PH certified component) and the two images show the rooflight installation internally. The inside face of the reveals were insulated with wood fibre insulation between battens (top left); then the airtight membrane from the ceiling was extended to connect to the rooflight frame (top right).

Roof windows:

2No. rooflights were installed, both by Lamilux. These were triple glazed aluminium clad thermally broken aluminium frame rooflights pre-installed to proprietary insulated upstands for flat roofs. One was a Passivhaus Certified component ‘Glass Element FE energysave’ (phA component) installed over the master ensuite shower; the other a non certified component to provide roof access, installed over the upper floor hallway.

Both rooflights have g-values of 0.51, and U-g values of 0.53W/m2K & 0.64W/m^{2}K for certified and non-certified rooflights respectively. The non-certified component has frame U-Values of 1.00W/m^{2}K, and a spacer PSI value of 0.052W/mK / 0.050W/mK.

Rooflights: Triple glazed, argon filled, thermally broken, aluminium finish frames on propritery integraged insulated upstands.

Average rooflight U-Value: 0.96W/m^{2}K

6 Description of the airtight envelope in Ostro Passivhaus; documentation of the pressure test result

The building achieved a very good result for the airtightness pressure test, at both the intermediate stage of construction, and upon completion.

The principle approach was to use an airtight and vapour control racking board, Spano Durelis Vapourblock, on the internal face of all of the external walls, with joints between boards, and staples, sealed using Pro Clima airtight tape Tescon Vana.

The connection to the concrete slab at the ground floor was via a proprietary membrane (Pro Clima DA) stapled to the board on the walls using Pro Clima Tescon Vana, with a bead of Pro Clima Orcon F adhesive to the slab.

Where internal stud walls intersected with the extenal wall, or where the intermediate floor sat on top of the ground floor wall head, we installed strips of Pro Clima Intello Plus airtight membrane during the timber frame assembly to ensure we could get continuity of the airtight barrier once the external frame was wind and water-tight.

Once the first floor chipboard deck was installed the membrane was pulled back towards the inside of the frame and taped to the Vapourblock board on the first floor walls.

This airtight layer was then extended into the window, door and rooflight reveals using Pro Clima Intello Plus membrane, and again all connections, joints and staples taped using Tescon Vana tape.

The first floor ceiling was covered in a layer of the same Intello Plus membrane, and taped to the top of the Vapourblock board on the first floor walls.

All service connections were sealed using proprietary Pro Clima grommets for cables and pipes, except for the MVHR ducts, which were sealed to the AVCL board using Tescon Vana due to their diameter.

Both pressure tests were carried out by Stewart King Architecture.

Intermediate Airtightness Test Result (at 50 Pascals): 0.1796 ACH
Test conducted on 13.03.2015

Final Test results:

Test Results

The initial normalized air flow at a pressure differential of 50 Pa was established in accordance with the required test methodology of ATTMA TSL1.

The key leakage characteristics of the building were calculated as follows:

Air Flow at 50 Pa, V_{50}	120.53 m³/h
Air Changes per Hour, n_{50}	0.1909 m³/(h.m³)
Air Permeability at 50 Pa, Q_{50}	0.2630 m³/(h.m²)
Correlation, r^2	0.9995
Exponent, n	0.795
Air Flow Coefficient, C_{env}	5.3670 m³/h
Air Leakage Coefficient, C_L	5.3670 m³/h

Appendix G – Combined Test Results

(Average of pressurisation and depressurisation tests)

Permeability at 50 Pa, AP_{50}	0.25165 m³/(h.m²)	**Air Changes per Hour, n_{50}**	0.18265 m³/(h.m³)

For the PHPP file the Certifier advised that we had to adjust the final figure to account for the building air volume measured in accordance with the EN 13829 measurement standards, as the testing was undertaken in accordance with ATTMA rquirements under BS EN ISO 9972: 2015.

Final Airtightness Test Result (at 50 Pascals) adjusted for volume: 0.0198507 ACH (or 0.2 ACH when rounded to one decimal place)
Test conducted on 19.10.2016.

7 Planning of Ventilation ductwork in Ostro Passivhaus

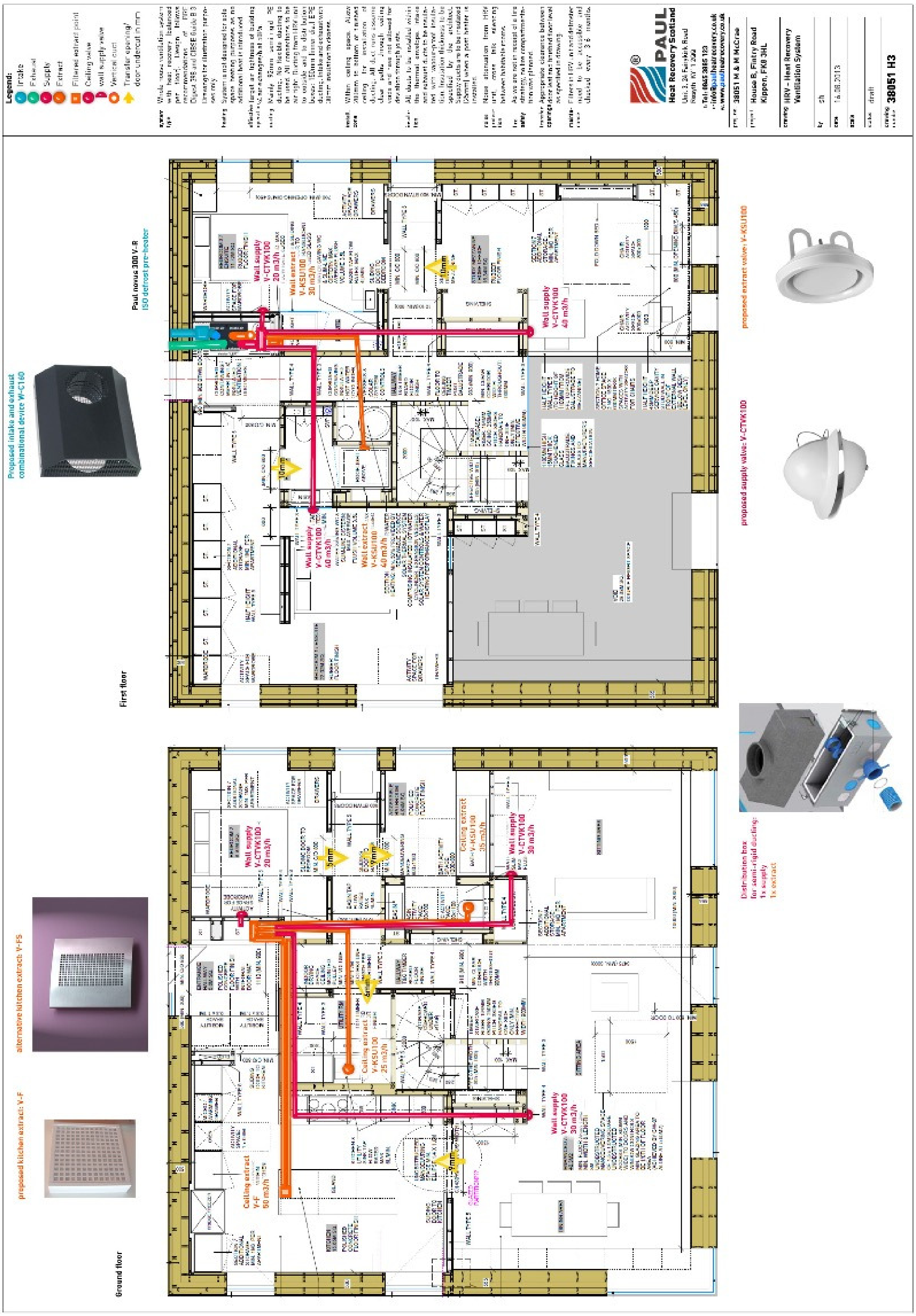
The MVHR design, installation and commissioning was carried out by Paul Heat Recovery Scotland. The unit installed was a Paul Novus 300, with a certified efficiency in this dwelling of 91.2%.

Ductwork was in rigid spiral bound for the extract, and semi-rigid for the extract. We sleeved the extract ducting in the positions where it would ultimately be visible, as the ducts were contained within a service zone above the halls, which was partially exposed via a slatted ceiling. Silencers were fitted in-line to the rigid ductwork, whilst the plennum acted as a cross-talk silencer for the semi-rigid system.

There is a 2kW electrical post heater installed so all supply ducting was insulated with proprietary insulation.

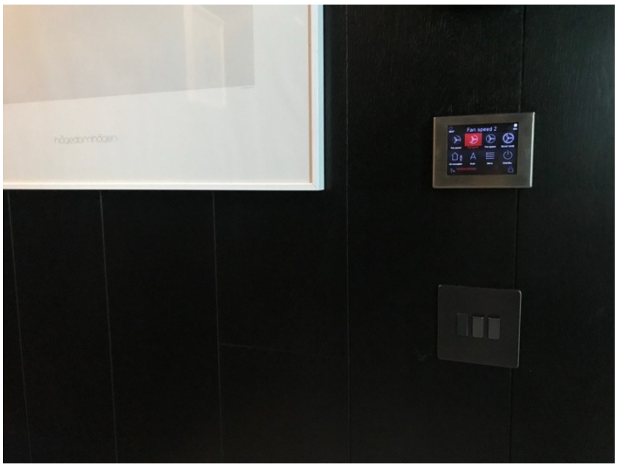
Transfer between supply rooms (living spaces & bedrooms) and extract rooms (utility, kitchen, bath & shower rooms) takes place via gaps at the base and sides of the sliding and pivot internal doors.

These photos show the ducts being installed. The insulated semi-rigid ducts sleeved over the hallways (top left); a silencer on the rigid duct system (bottom left); the combination of rigid and semi-rigid ducts (right).



MVHR Layouts for Ostro Passivhaus

The control panel was installed in the main hall and valves were powder coated to match the wall finishes.



The post heater (top left)
The control panel (middle left)
The kitchen extract grille (bottom left)
The Paul unit (to right)
An extract in a shower (middle right)
A supply in the main living space (bottom right)

8 Heat supply in Ostro Passivhaus (space heating & hot water)

The space heating is supplied via 4No. Infrared heating panels by Yandiya. 1No. Is 500W, and 3No. Are 800W. All are individually thermostatically controlled with Salus or Heatmiser controls. The 2kW post heater on the MVHR ductwork is controlled separately by a Nest thermostat in the upper floor hallway. The thermostats for the IR panels are wireless and connect via a mains powered relay switch.

These images show the IR panel on the ceiling in the kitchen (top left); an individual panel thermostat (top right).

The hot water heating is provided via Solfex 'CPC 12 OEM' evacuated tube solar thermal panels. There are 2No. 12 tube panels on the roof, equal to 4m² of aperture area. The panels face due south and are on an optimum 45° angle from horizontal, with no shading. These are connected to a 300L Gledhill twin-coil solar hot water cylinder, with back-up 3kW electric immersion heater located in a cupboard on the first floor.

In addition there is a vertical Waste Water Heat Recovery (WWHR) unit by Recoup, Recoup+HE, fitted below the master bedroom ensuite shower and connected to both the shower and the HWC (System A installation), which was included in the PHPP, and all fixtures and fittings within the dwelling are low flow to reduce the water demand overall.

There are also 6No. (9.9m^2) 250W Mono Si PV panels by Solarworld on the roof (see above), which are estimated by the PHPP to provide 1156kWh/a electricity yield.

9 PHPP Calculations in Ostro Passivhaus

The Verification page from the Certification PHPP and the Certification document is included below.

cocreate

19/10/2017

Passive House Verification

Building:	OSTRO
Street:	FINTRY ROAD
Postcode/City:	FK8 3HL KIPPEN
Province/Country:	STIRLINGSHIRE GB-United Kingdom/ Britain
Building type:	DETACHED DWELLING
Climate data set:	GB0015b-Glasgow Airport
Climate zone:	3: Cool-temperate — Altitude of location: 100.125 m
Home owner / Client:	MR & MRS MCCRAE
Street:	FINTRY ROAD
Postcode/City:	FK8 3HL KIPPEN
Province/Country:	STIRLINGSHIRE GB-United Kingdom/ Britain
Architecture:	PAPER IGLOO LTD.
Street:	FINTRY ROAD
Postcode/City:	FK8 3HL KIPPEN
Province/Country:	STIRLINGSHIRE GB-United Kingdom/ Britain
Mechanical system:	PAUL HEAT RECOVERY SCOTLAND
Street:	24 FAIRYKIRK ROAD, UNIT 3
Postcode/City:	KY11 2QQ ROSYTH
Province/Country:	FIFE GB-United Kingdom/ Britain
Energy consultancy:	PAPER IGLOO LTD.
Street:	FINTRY ROAD
Postcode/City:	FK8 3HL KIPPEN
Province/Country:	STIRLINGSHIRE GB-United Kingdom/ Britain
Certification:	COCREATE CONSULTING
Street:	3 DUFFERIN AVENUE
Postcode/City:	EC1Y 8PQ LONDON
Province/Country:	LONDON GB-United Kingdom/ Britain

Year of construction:	2017	Interior temperature winter [°C]:	20.0	Interior temp. summer [°C]:	25.0
No. of dwelling units:	1	Internal heat gains (IHG) heating case [W/m²]:	2.4	IHG cooling case [W/m²]:	2.4
No. of occupants:	3.0	Specific capacity [Wh/K per m² TFA]:	84	Mechanical cooling:	

Specific building characteristics with reference to the treated floor area

				Criteria	Alternative criteria	Fulfilled?[2]
	Treated floor area m²	170.0				
Space heating	Heating demand kWh/(m²a)	15	≤	15	-	yes
	Heating load W/m²	11	≤	-	10	
Space cooling	Cooling & dehum. demand kWh/(m²a)	-	≤	-	-	-
	Cooling load W/m²	-	≤	-	-	
	Frequency of overheating (> 25 °C) %	4	≤	10		yes
	Frequency excessively high humidity (> 12 g/kg) %	0	≤	20		yes
Airtightness	Pressurization test result n_{50} 1/h	0.2	≤	0.6		yes
Non-renewable Primary Energy (PE)	PE demand kWh/(m²a)	79	≤	-		-
Primary Energy Renewable (PER)	PER demand kWh/(m²a)	37	≤	60	60	yes
	Generation of renewable energy kWh/(m²a)	31	≥	-	-	

[2] Empty field: Data missing; '-': No requirement

I confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.

Passive House Classic? **yes**

Task	First name	Surname	Signature
2-Certifier	Will	South	
Certificate ID	**Issued on**	**City**	
16821_Cocreate_PH_20171018_WS	19/10/17	London	

Certificate

Certified Passive House Classic

cocreate

Cocreate Consulting
3 Dufferin Avenue
London
EC1Y 8PQ

Authorised by:

Passive House Institute

Dr. Wolfgang Feist
64283 Darmstadt
Germany

OSTRO
FINTRY ROAD, FK8 3HL KIPPEN, United Kingdom

Certified
Passive House
Passive House Institute
| classic | plus | premium |

Client	MR & MRS MCCRAE FINTRY ROAD FK8 3HL KIPPEN, United Kingdom/ Britain
Architect	PAPER IGLOO LTD. FINTRY ROAD FK8 3HL KIPPEN, United Kingdom/ Britain
Building Services	PAUL HEAT RECOVERY SCOTLAND 24 FAIRYKIRK ROAD, UNIT 3 KY11 2QQ ROSYTH, United Kingdom/ Britain
Energy Consultant	PAPER IGLOO LTD. FINTRY ROAD FK8 3HL KIPPEN, United Kingdom/ Britain

Passive House buildings offer excellent thermal comfort and very good air quality all year round. Due to their high energy efficiency, energy costs as well as greenhouse gas emissions are extremely low.

The design of the above-mentioned building meets the criteria defined by the Passive House Institute for the 'Passive House Classic' standard:

Building quality		This building		Criteria	Alternative criteria
Heating					
Heating demand	[kWh/(m²a)]	15	≤	15	-
Heating load	[W/m²]	11	≤	-	10
Cooling					
Frequency of overheating (> 25 °C)	[%]	4	≤	10	
Airtightness					
Pressurization test result (n_{50})	[1/h]	0.2	≤	0.6	
Renewable primary energy (PER)					
PER-demand	[kWh/(m²a)]	37	≤	60	60
Generation (reference to ground area)	[kWh/(m²a)]	31	≥	-	-

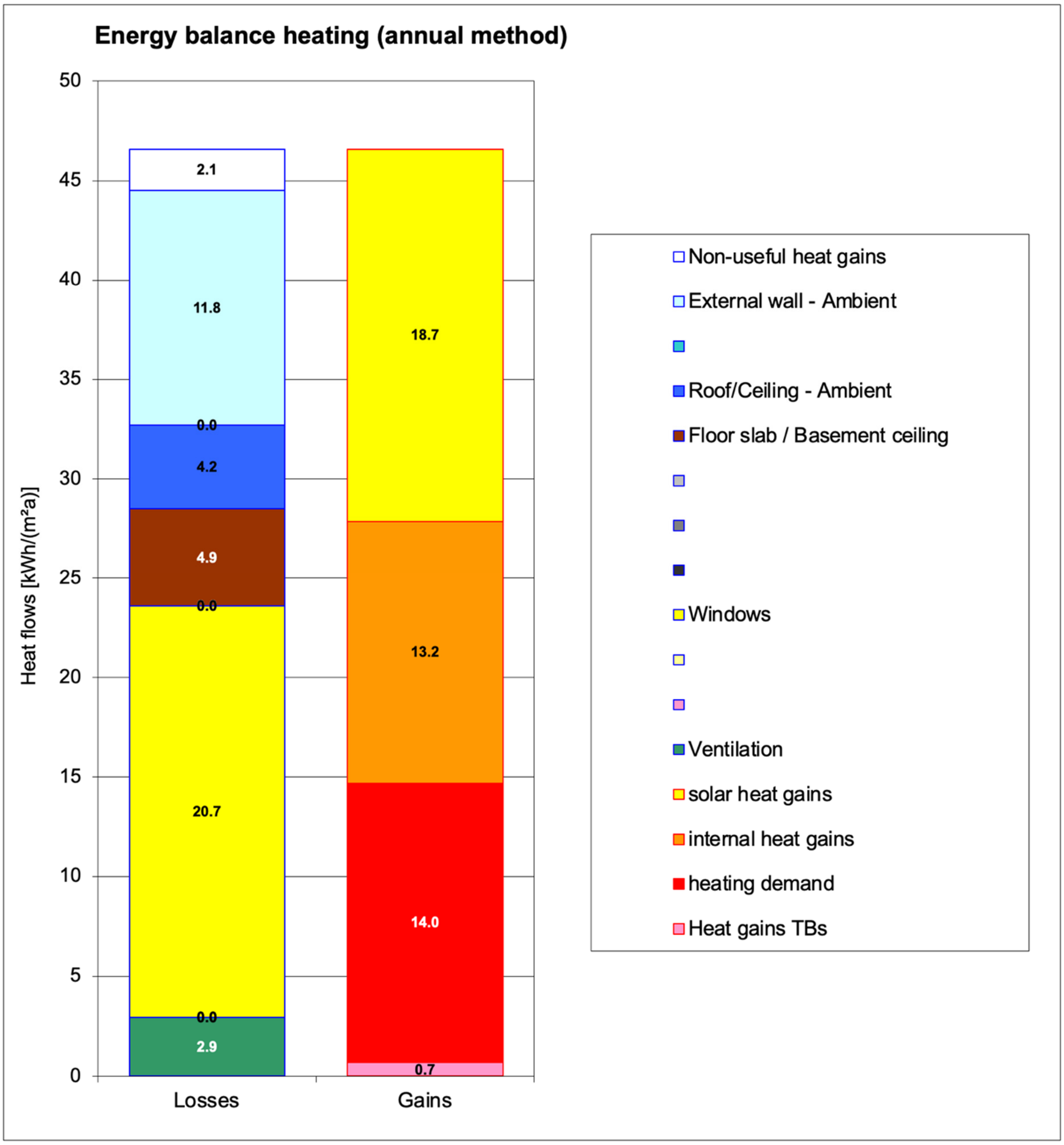
The associated certification booklet contains more characteristic values for this building.

London, UK

Certifier: Will South, COCREATE CONSULTING

www.passivehouse.com

16821_Cocreate_PH_20171018_WS



The energy balance (annual method) shows that the losses from windows (20.7kWh/m².a) are under half of the total losses, and these are almost balanced by the solar gains (18.7kWh/m².a).

10 Construction costs in Ostro Passivhaus

The house was largely built by the architect and her husband (the owners), and is of an unusual architectural design. If the savings made by the owners for the labour costs were equated to an additional sum, then it is estimated that the construction cost would be in-line with current building rates for an unusual and bespoke house, of approximately £2000/m2. It would be typical in a new build in this area to have UFH installed throughout both floors: it is estimated by the architect that the money not spent on that would roughly equate to the additional insulation and detailing around windows.

11 Measured results of the inhabited Ostro Passivhaus

Despite living in the property for several years now, we have only recently started to monitor the indoor air temperature and humidity in relation to the same externally. We have done this to verify our anecdotal feelings that the house is performing as expected.

In terms of energy use: the house is performing very much as expected, and as predicted by the PHPP.

Total energy use (TFA: 170.04m²):

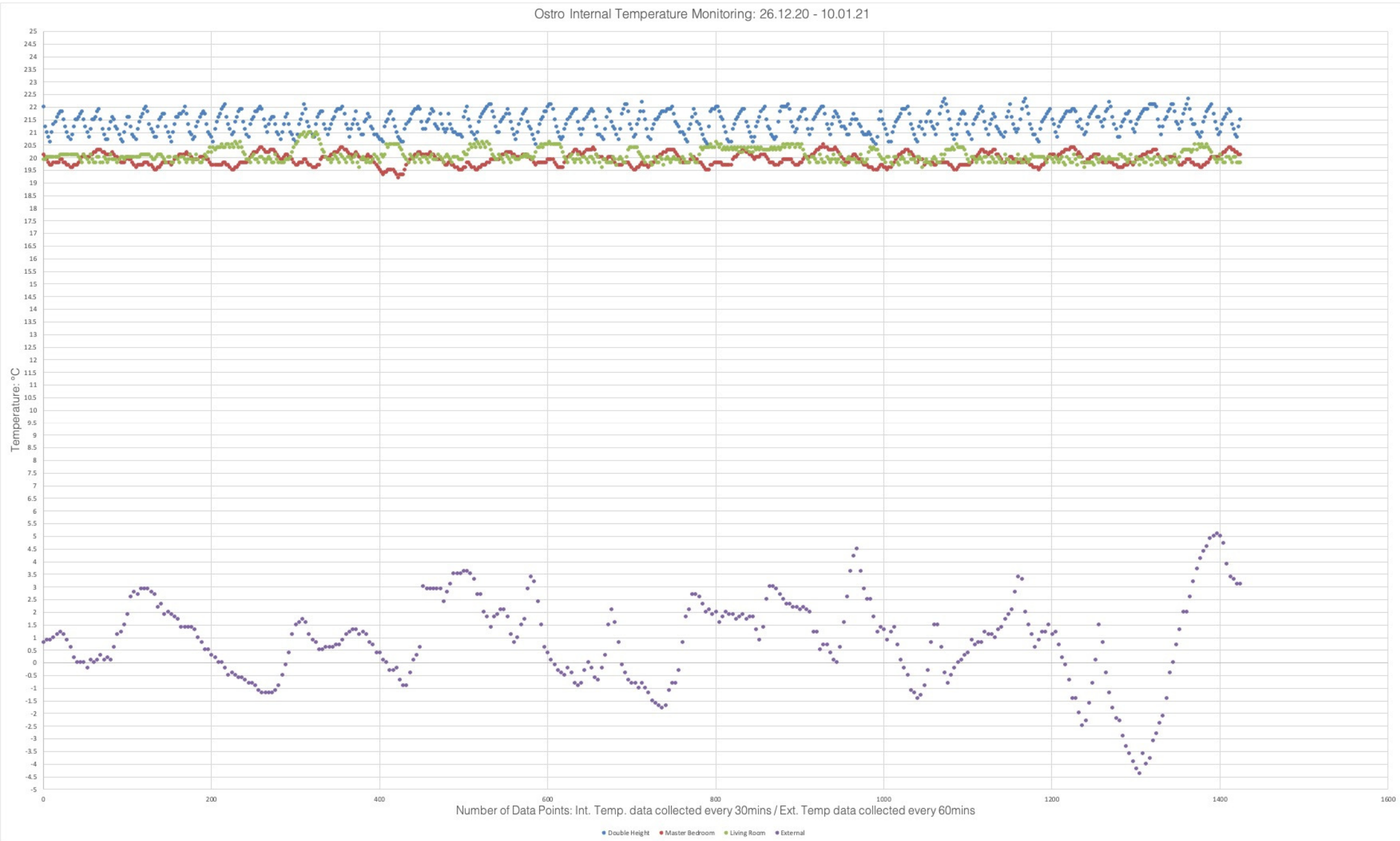
Predicted PHPP PER: 37.38kWh(m².a). Predicted total energy use: 6356kWh.a

Measured energy use: 16.10.2019 – 16.10.2020 = 6392kWh.a.

Equivalent PER figure of 37.59 kWh(m².a)

This is less than a 1% difference.

Below is a graph of the indoor air temperature in 3 locations: living room, master bedroom, and top of double height space, in relation to external air temperature for the same period. The indoor temperatures are very stable, and only vary within a c. 1-2° range. It is planned to continue this over a full year to also verify the overheating risk prediction.



END.